HEATING SYSTEMS

THERMO G

Installation instructions

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SPHEROS

Improper installation or repair of Spheros heating and cooling systems can cause fire or the leakage of deadly carbon monoxide leading to serious injury or death.

To install and repair Spheros heating and cooling systerns you need to have completed a Spheros training course and have the appropriate technical documentation, special tools and special equipment.

NEVER try to install or repair Spheros heating or cooling systems if you have not completed a Spheros training course, you do not have the necessary technical skills and you do not have the technical documentation, tools and equipment available to ensure that you can complete the installation and repair work properly.

ALWAYS carefully follow Spheros installation and repair instructions and heed all WARNINGS.

Spheros rejects any liability for problems and damage caused by the system being installed by untrained personnel.

Highlighted words like Warning, Caution, ATTENTION and NOTE in these evacuation and charging instructions signify the following precautions:

This caption is used to indicate possible severe injuries or fatal accidents if instructions or procedures are carried out incorrectly or entirely disregarded.

This caption is used to indicate possible minor injuries if instructions or procedures are carried out incorrectly or entirely disregarded.

ATTENTION: This caption points to actions which may cause material damage.

NOTE: This caption is used to draw attention to an important feature.

NOTE: Subject to modification. In multilingual versions the German language is binding. The latest version of this document you will find in the download center on **www.spheros.com**.

Table of Contents

1 Introduction

1.1. General

These installation instructions will give you the necessary information so that the heater is working properly and safely after installation.
For questions on heater operating, refer to the Operating and service instructions. This manual is supplied with the heater.
First, read both documents carefully please. You can then consider all the tips and hints contained therein already in your planning for the installation of the heater with.

ATTENTION:
The installation of the heater must only be performed by Spheros trained personnel.

1.2. Use of the water heaters

The water heaters, hereafter referred to as heaters, are used in conjunction with the vehicle's own heating system
– to heat the passenger cabin, and
– for pre-hating.

The heater may only be installed and operated in vehicles of the class **M1, M2, M3, N1, N2, N3, O1, O2, O3, O4**.

Any use beyond is not permitted.

The heaters operate independently of the engine and are connected to the cooling system, the fuel system and the electrical system of the vehicle.

Warning!	**Danger to life and health!**

The heater is not approved for use in vehicles carrying dangerous goods according to Annex 9 of the UN/ECE Regulation R122.

Warning!	**Risk of fire, explosion, poisoning and asphyxiation!**

The heater must not be operated:

- **at filling stations and other refueling points.**
- **if the heater or its exhaust outlet is in locations where inflammable vapors or dust may form (e.g. close to fuel, plastic, coal, wood dust or cereal storage facilities or similar).**
- **if the heater or its exhaust outlet is located close to inflammable materials for example dry grass and leaves, cartons, paper etc.**
- **in enclosed areas (e.g. garages, hall without extraction system), not even if the pre-selection timer or Tele Start is used.**
- **if the exhaust outlet of the heater is partial or fully obstructed (e.g. by soil or snow, as it may occur while move the vehicle backwards).**

The heater must:

- **be shut down and the fuse shall be removed in the event of extensive smoke development, unusual combustion noises or fuel odors. The heater must not be used again until personnel trained by Spheros have examined it.**

The water heater is designed for operation with CNG (Compressed Natural Gas).

2 Version

Thermo G 300 – 24V
Water heater for natural gas (CNG) of classes H and L with a heat current of 30 kW (26,000 kcal / h).

ATTENTION:
The heater is factory set for use with CNG class H (methane content > 95%). For more information on fuel refer to Section 10.

3 Statutory regulations governing installation

3.1. Statutory regulations governing installation

For the heater exists a type approval according to the ECE Regulations

R10 (EMV): No. 06 7263 and
R122 (Heater) No. 00 0447.

Installation is governed above all by the provisions in Annex 7 of the ECE Regulation R122.

NOTE:
The provisions of these Regulations are binding within the territory governed by ECE Regulations and should similarly be observed in countries without specific regulations!

(Extract from ECE Regulation R122, Annex 7)

„...

4 The heater must have a manufacturer's label showing the manufacturer's name, the model number and type together with its rated output in kilowatts. The fuel type must also be stated and, where relevant, the operating voltage and gas pressure.

(...)

7.1 A clearly visible tell-tale in the operator's field of view shall inform when the combustion heater is switched on or off.

..."

Extract from ECE Regulation R122, Part I:

„ ...

5.3 Vehicle Installation Requirements for Combustion Heaters

5.3.1 Scope

5.3.1.1 Subject to paragraph 5.3.1.2., combustion heaters shall be installed according to the requirements of paragraph 5.3.

5.3.1.2 Vehicles of category O having liquid fuel heaters are deemed to comply with the requirements of paragraph 5.3.

5.3.2 Positioning of combustion heater

5.3.2.1 Body sections and any other components in the vicinity of the heater must be protected from excessive heat and the possibility of fuel or oil contamination.

5.3.2.2 The combustion heater shall not constitute a risk of fire, even in the case of overheating. This requirement shall be deemed to be met if the installation ensures an adequate distance to all parts and suitable ventilation, by the use of fire resistant materials or by the use of heat shields.

5.3.2.3 In the case of M2 and M3 vehicles, the combustion heater must not be positioned in the passenger compartment. However, an installation in an effectively sealed envelope which also complies with the conditions in paragraph 5.3.2.2. may be used.

5.3.2.4 The label referred to in Annex 7, paragraph 1.4., or a duplicate, must be positioned so that it can be easily read when the heater is installed in the vehicle.

5.3.2.5 Every reasonable precaution should be taken in positioning the heater to minimize the risk of injury and damage to personal property.

5.3.3 Fuel supply

5.3.3.1 The fuel filler must not be situated in the passenger compartment and must be provided with an effective cap to prevent fuel spillage.

5.3.3.2 In the case of liquid fuel heaters, where a supply separate from that of the vehicle is provided, the type of fuel and its filler point must be clearly labelled.

5.3.3.3 A notice, indicating that the heater must be shut down before refuelling, must be affixed to the fuelling point. In addition a suitable instruction must be included in the manufacturer's operating manual.

5.3.4 Exhaust system

5.3.4.1 The exhaust outlet must be located so as to prevent emissions from entering the vehicle through ventilators, heated air inlets or opening windows.

5.3.5 Combustion air inlet

5.3.5.1 The air for the combustion chamber of the heater must not be drawn from the passenger compartment of the vehicle.

5.3.5.2 The air inlet must be so positioned or guarded that blocking by rubbish or luggage is unlikely.

(...)

5.3.8 Automatic control of the heating system

5.3.8.1 The heating system must be switched off automatically and the supply of fuel must be stopped within five seconds when the vehicle's engine stops running. If a manual device is already activated, the heating system can stay in operation.

...“

(Extract from ECE Regulation R122, - Annex 8, apply analogously to CNG)

1. LPG HEATING SYSTEMS FOR ROAD USE IN MOTOR VEHICLES

1.1 If an LPG heating system in a motor vehicle can also be used when the vehicle is in motion, the LPG combustion heater and its supply system shall comply with the following requirements:

1.1.1 The LPG combustion heater shall comply with the requirements of the harmonized standard EN 624:2000 (Specifications for dedicated LPG appliances. Room sealed LPG space heating equipment for installation in vehicles and boats).

1.1.2 In cases of a permanently installed LPG container all components of the system that are in contact with LPG in the liquid phase (all components from the filling unit to the vaporiser/pressure regulator) and the associated liquid phase installation shall comply with the technical requirements of Regulation No 67, Parts I and II and Annexes 3 to 10, 13 and 15 to 17.

1.1.3 The gaseous phase installation of the LPG heating system in a vehicle shall comply with the requirements of the harmonized standard EN 1949:2002. ([1]) (Specifications for the installation of LPG systems for habitation purposes in leisure accommodation vehicles and in other road vehicles).

1.1.4 The LPG supply system shall be so designed that the LPG is supplied with the required pressure and in the correct phase for the installed LPG combustion heater. It is permitted to withdraw LPG from the permanently installed LPG container in either gaseous or liquid phase.

1.1.5 The liquid outlet of the permanently installed LPG container to supply LPG to the heater shall be provided with a remotely controlled service valve with excess flow valve as required in paragraph 17.6.1.1 of Regulation No 67. The remotely controlled service valve with excess flow valve shall be controlled such that it is automatically closed within five seconds of the vehicle engine stopping, irrespective of the position

of the ignition switch. If within these five seconds the on-switch of the heater or LPG supply system is activated, the heating system may stay in operation. The heating can always be restarted.

1.1.6 If the LPG is supplied in the gaseous phase from the permanently installed LPG container or separate portable LPG cylinder(s), appropriate provisions shall be taken to ensure that:

1.1.6.1 no liquid LPG can enter the pressure regulator or LPG combustion heater. A separator may be used, and

1.1.6.2 no uncontrolled release due to an accidental disconnection can occur. Means shall be provided to stop the flow of LPG by installing a device directly after or in a cylinder or container mounted regulator or if the regulator is mounted remote from the cylinder or container, a device shall be installed directly before the hose or pipe from the cylinder or container and an additional device shall be installed in, or after the regulator.

1.1.7 If the LPG is supplied in liquid phase, the vaporiser and pressure-regulator unit shall be heated as appropriate by a suitable heat source.

1.1.8 In motor vehicles that use LPG in their propulsion system, the LPG combustion heater may be connected to the same permanently installed LPG container that supplies LPG to the engine, provided that the safety requirements of the propulsion system are met. If a separate LPG container is used for heating, this container shall be provided with its own filling unit.

ATTENTION:
Failure to follow the installation instructions and the notes contained therein will lead to all liability being refused by Spheros. The same applies if repairs are carried out incorrectly or with the use of parts other than genuine spare parts. This will result in the invalidation of the type approval for the heater and therefore of its homologation / ECE Type licence.

Warning!	**Fire and explosion hazard!**

At petrol stations and other fuel filling facilities the heater must be switched off due to the explosion hazard. To advice to this requirement the self-adhesive label with the text ”Switch off heater before refueling!“, delivered with each heater, is to be affixed next to the filler neck.

3.2. General Regulations

The heater must not be installed in the driver’s cab or passenger cabin of buses.

The heater is not approved for installation in vehicles used for carriage of dangerous goods (ECE Regulation R122 - Annex 9).

In regard to the routing of gas pipes the regulations of ECE R110 are to be considered.

Gas pipes must be designed in such a way that torsion in the vehicle, movements by the engine and the like do not have a negative effect on their durability. They must be protected from mechanical damage. Gas pipes must not be installed in the passenger cabin or driver’s cab of buses. Parts that carry gas must be positioned such that in the event of a fire the entry and exit points are not place in immediate danger. The parts that carry gas must be inspected on a regular, annual basis. Leaking or damaged parts must be replaced with genuine spare parts.

4 Other regulations

Follow the instructions supplied by the vehicle manufacturer to check the cooling water level. The water in the heating system must contain at least 30 %, maximum 60% of a branded anti-freeze.
If you use pure water, if it overheats you may lose some of the cooling water as a result of its low boiling point, and this will then have to be topped up.
Additives in the heating system must not be aggressive to metal, plastic or rubber and must not form any deposits.

The opening pressure in the vehicle's cooling system (generally specified on the coolant sealing cover) must be between 0.4 and 2.0 bar.

A temperature of 100 °C (storage temperature) must not be exceeded in the vicinity of the control device (for example when completing painting work on the vehicle).
If this temperature is exceeded, the electronic systems may suffer permanent damage.

The heaters must only be operated with natural gas (CNG).

Due to the hardly audible combustion noise of the heater, particular care is required when working near the device. In such cases the heater shall be always protected against an inadvertent on-switching.

5 Installation

The Thermo G water heater must only be installed outside the passenger cabin or driver's cab.

WARNING!	**Danger to life and health!**

The statutory regulations and other directives governing installation set out in Sections 3 and 4 must be adhered to.

ATTENTION:

- **The heater and all other components belonging to the system shall be always installed in such a way that a negative impact by road dirt, splashing water, exhaust gases or other harmful influences is excluded.**
- **Do not install the heater near hot parts carrying exhaust fumes.**
- **There must be no inflammable and absorbent materials in the vicinity.**
- **There must be not oil filler neck or oil filters above the heater.**
- **The adjustable gas jet on the burner must be freely accessible.**
- **To the temperature sensor cable no mechanical load must be applied (e.g. carry the heater with it).**

NOTE:
Consider the installation situation of the relevant vehicle type.

5.1. Installation location

The preferred mounting location of the heater is the engine compartment of the vehicle. The heater and the circulation pump are to be integrated into the cooling system.

The heater and the circulating pump must be installed in as low a position as possible to allow the heater and circulating pump to be bled automatically. This is particularly important as the circulating pump is not self-priming.

If it is not possible to install the heater in the vehicle's engine bay it may be installed in a box. The installation box must have sufficient external ventilation to ensure that the maximum temperature of 85°C is not exceeded in the box.

Adequate external ventilation of at least 100 cm^2 must be provided at the highest point of the installation space.
The ventilation opening must be positioned in such a way that no gas can ingress into the interior.

Bear in mind the space required for servicing accessibility when installing the heater. The hood and the burner housing with mixing chamber must be removable, the CO_2 adjustment screw must be accessible (see fig. 1).

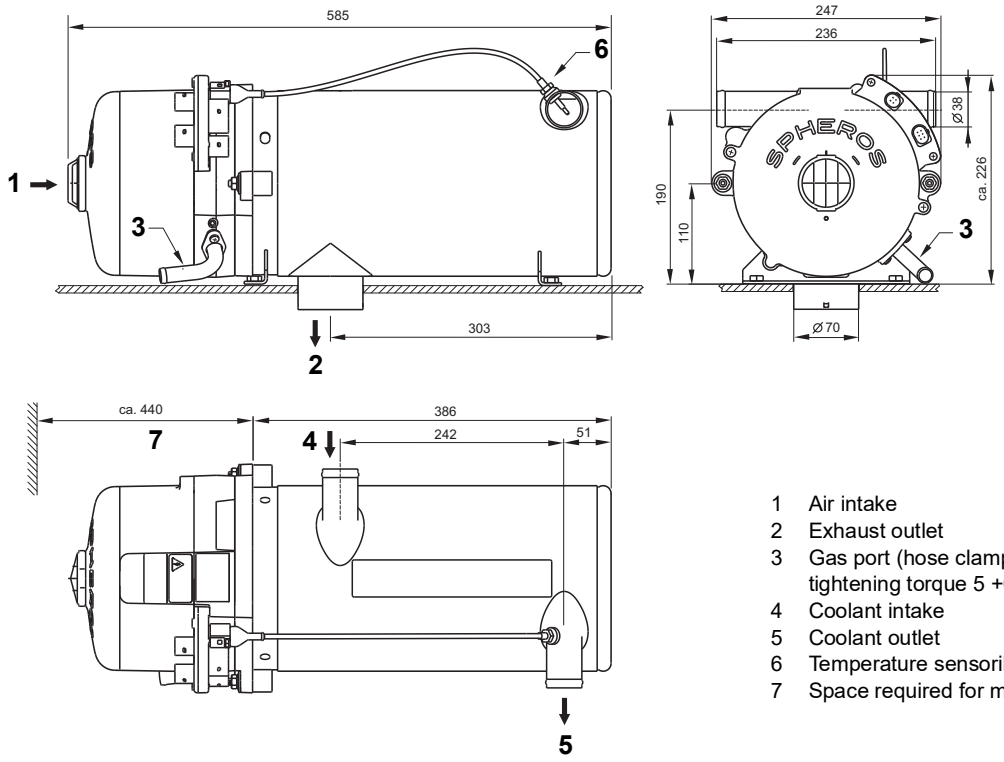
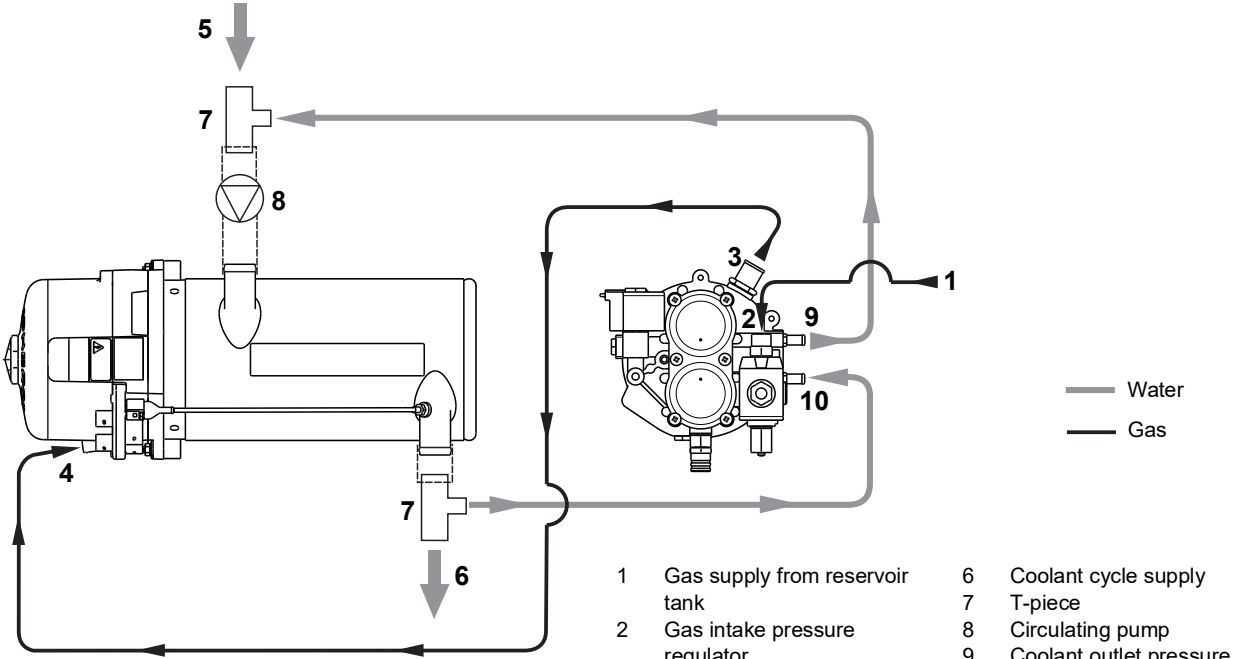


Figure 1: Dimensions of the heater Thermo G



1	Gas supply from reservoir tank	6	Coolant cycle supply
2	Gas intake pressure regulator	7	T-piece
3	Gas outlet pressure regulator	8	Circulating pump
4	Gas port heater	9	Coolant outlet pressure regulator
5	Coolant cycle return	10	Coolant inlet pressure regulator

Figure 2: Connection diagram of the heater Thermo G

5.2. Heater installation

NOTE:
The heaters are only licensed for horizontal installation (see Fig. 3).

The heater is secured with four screws M8 (see fig. 4).
Use washers acc. to DIN 125 if necessary.

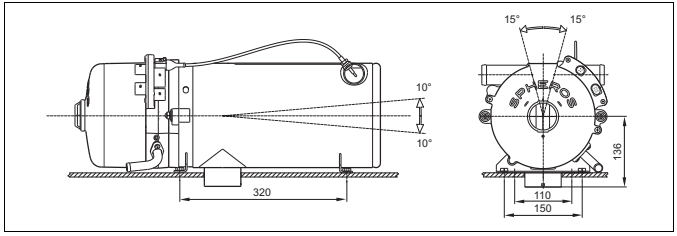


Figure 3: Installation position

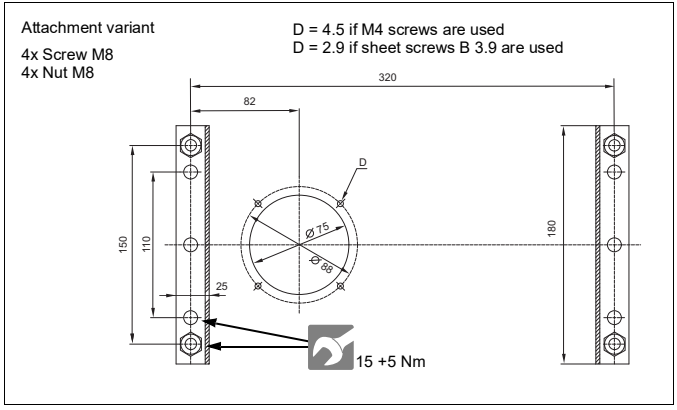


Figure 4: Hole pattern

5.3. Model plate

The model plate must be protected from damage and must be clearly legible when the heater is installed (otherwise a duplicate model plate must be used).

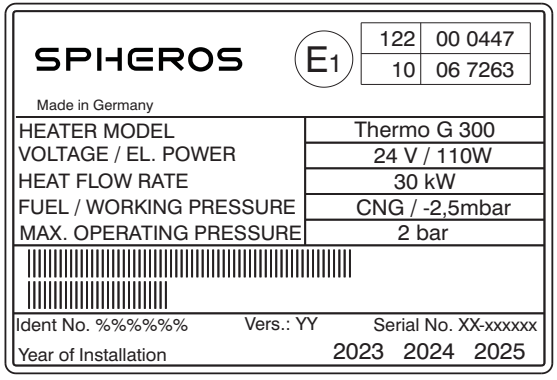


Figure 5: Heater model plate example

NOTE:
The year of the initial operation must be durably marked by removing the year numbers that are not applicable.

6 Example for installation

Water heating circuit – wall heater and roof duct heating system

1 Wall heater with blower
2 Heat exchanger at entry point
3 Heater
4 Circulating pump
5 Roof heat exchanger
6 Vehicle engine
7 Driver's position heating system
8 Control element
9 Gas tanks
10 Gas pressure regulator
11 Ventilation slots
(at the highest point)

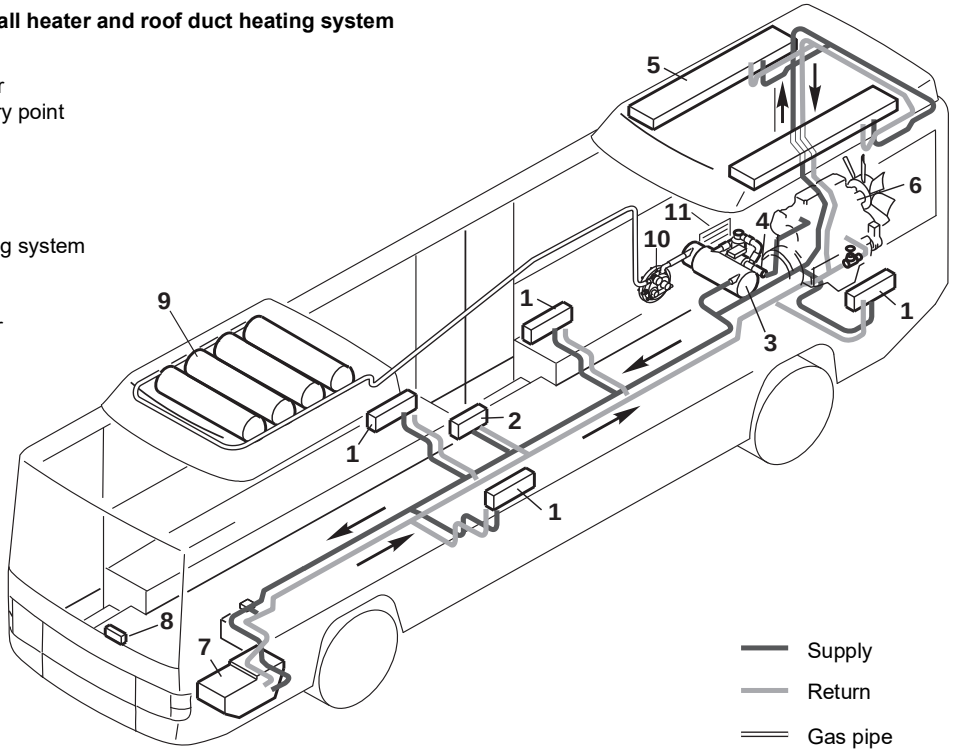


Figure 6: Installation example for the Thermo G heater in a bus

7 Gas pressure regulator

With the heater a gas regulator is supplied with. Its proper installation is crucial for the proper and safe operation of the heater.

7.1. Function

The pressure regulator regulates the storage pressure (max. 220 / min. 5 bar) downward to the required working pressure in three steps.
By means of a membrane valve in the pressure regulator, the required amount of gas is passed under low pressure conditions.
The expansion of the gas in the pressure regulator results in it cooling. To prevent its freezing the pressure regulator must be heated with water!

7.2. Gas pressure regulator installation

Install the gas pressure regulator onto a suitable position near to the heater. The maximum length of the gas supply hose from the gas pressure regulator to the heater is 1 m.

The gas regulator must be mounted longitudinally to the direction of travel. For mounting it, a threaded stud bolt M10 is provided on the front of the housing. Permissible inclinations with which it can be fixed are shown in figure 8.

The pressure regulator requires servicing and it must therefore be possible to remove and install it. An approved shut-off cock is to be installed upstream of the pressure regulator so that the regulator can be serviced. The drain screw must be freely accessible.

The water connection for the gas pressure regulator is accomplished in according to the connection diagram (fig. 2) to the appropriate ports (see fig. 8).

A hose must be connected to the CNG gas pressure regulator safety valve and secured with a clamp. The hose must be lead upwards into the open air, via the roof or via the gas ventilation of the engine. The ingress of water into the safety valve through the hose must be prevented!

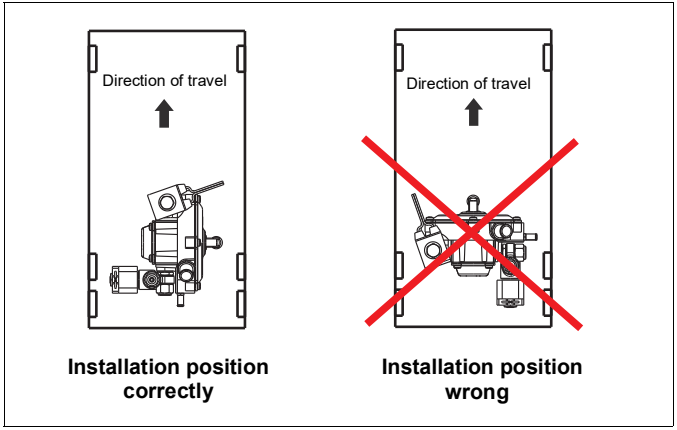


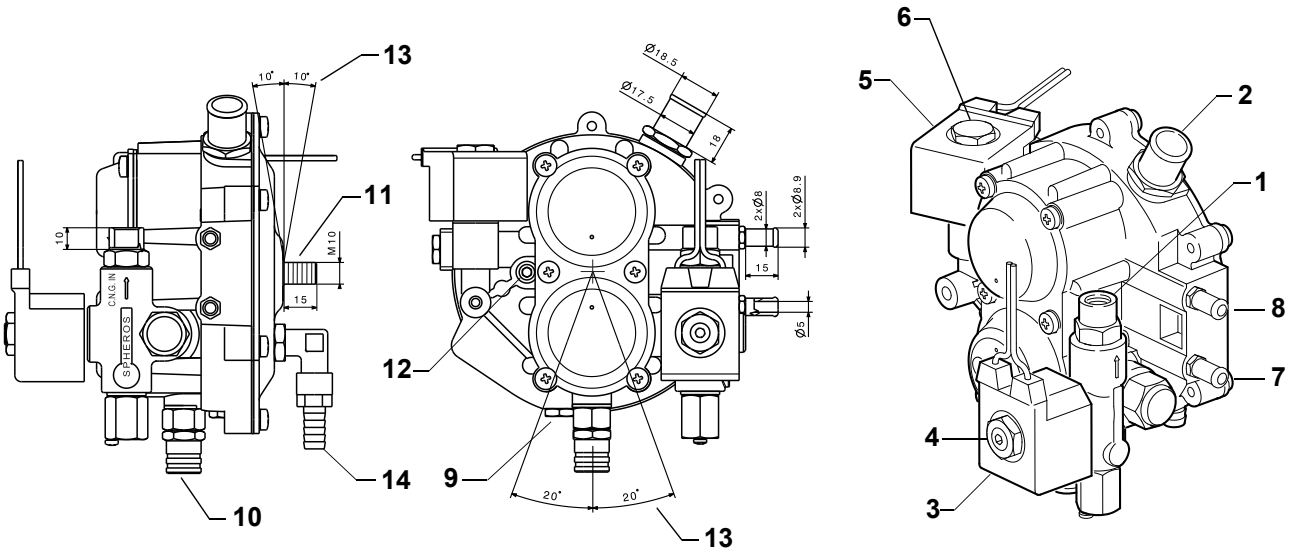
Figure 7: Installation position of the gas pressure regulator

7.3. Replacement interval

In keeping with the manufacturer's instructions, the pressure regulator must be replaced every four years. Otherwise leaks and gas release may occur due to the ageing of the seals.

7.4. Pressure regulator gas supply

Necessarily, consider section 10 for details of system integration.



1 Gas inlet, M12x1, torque 25 Nm
2 Gasoutake, torque hose clamp 5 +0,5 Nm
3 High-pressure solenoid valve, 1st stage
4 Attaching nut, SW17, torque 5 +2/-1 Nm
5 Low-pressure solenoid valve, 2nd stage
6 Attaching nut, SW17, torque 9 +2/-1 Nm
7 Water intake, torque hose clamp 1.2 Nm
8 Water outlet, torque hose clamp 1.2 Nm
9 Oil drain screw
10 Safety valve
11 Mounting stud bolt, torque 20 ± 2 Nm
12 Calibration screw (secured with safety varnish and silicone)
13 Admissible fitting positions
14 Reference pressure connection (no hose needs to be connected).

Figure 8: Gas pressure regulator

8 Installation of the circulating pump

ATTENTION:
The heater should be equipped with a Spheros circulating pump. Pumps of other manufacturers must be approved by Spheros.

The following pumps are available:

- U4814 (Aquavent 5000)
- U4854 (Aquavent 5000S)
- U4855 (Aquavent 6000C)
- U4856 (Aquavent 6000SC)
- SPump S120
- SPump S200

NOTE:
Information about these pumps and their installation you find in the download center on www.spheros.com.

NOTE:
- The annex of this Installation instructions contains the permitted installation positions of the pumps.
- The pump ports and connection lines from the water intake and water outlet must be flush (no stress).

ATTENTION:
- **Only ONE circulating pump may be connected to the heater.**
- **When connecting the circulating pump U4856 it must be ensured that the volume flow does not drop below 2500 l/h for longer than a brief period only! Continuous operation at less than 2500 l/h will result in an undue wear of the wearing disc of the impeller!**

ATTENTION:

If circulation pumps are to be used that are not specified in these installation instructions, ensure that their continuous current consumption does not exceed 10 A.

If the pump is not controlled via the heater, it is essential to ensure its operation during the entire heater's operating time (pre-run, heating operation, and run-on).

If the pump is not connected directly via the heater's wiring harness, appropriate protection for the circulation pump must be provided.

Supplying external voltage via the circulation pump output on the control unit is not permitted!

If the circulation pump output on the control unit is not required, it must be sealed with a dummy plug (ID No.: 11113969_) (please order separately) to protect the control unit from moisture ingress.

9 Connection to the vehicle cooling system

The heater is connected to the vehicle cooling system as shown in the connection diagram in Figure 2. The system must contain at least 25 liters of coolant. The water in the heating system must contain at least 30 %, maximum 60% of a branded anti-freeze.

The water hoses must at least comply with DIN 73411. The hoses must be installed without kinks and (to ensure perfect bleeding) rising if possible. Hose connections must be supported by hose clips to prevent them slipping.

NOTE:
The tightening torque of the used hose clamps must be considered. Ensure that the water hoses have chafing guards and can move freely.

Only pressure valves with an opening pressure of min. 0.4 bar and max. 2.0 bar may be used in the vehicle's cooling system.

The cooling system must be bled carefully before using the heater for the first time or after replacing the coolant. The heater and lines should be installed in such a way as to ensure static bleeding. Any shut-off cocks in the cooling system must be opened.

Perfect ventilation can be identified by the circulating pump operating almost silently. Poor bleeding may cause the temperature limiter to trip whilst the heater is operating.

10 Fuel Supply

ATTENTION:
The heater may only be operated using natural gas (CNG).

Fuel: Natural gas (CNG) with a minimum methane content of 95 %. If the methane content is less than the heater's gas jet must be adjusted by Spheros trained personnel. The max. oil content of the gas is 10 mg/m^3.

It is also recommended to adjust the CO_2 level according to the specified technical data when suction-or exhaust-side applications are used.

The fuel must be taken from the tank or from the immediate vicinity of the tank. The fuel must not be taken from the filler line or from places at which oil and condensate may collect. The fuel extractor is to be designed such that as little oil and condensate can get into the heater supply line as possible (outlet at the top). If the gas quality is poor (contaminated), shorter servicing intervals may be required (see Section 15).

10.1. Fuel lines

ATTENTION:
For fuel line routing consider the following:
- **The lines must be protected from the effects of high temperatures. The outer shell of the heater may reach a temperature of approx. 220 °C if it overheats.**
- **The lines must be protected from stone damage.**

The fuel lines on the high pressure side must be made of stainless steel. The couplings shall have double cutting rings (for example Swagelok). All parts of the high pressure side must be approved pursuant to ECE R110 for CNG.

Only the genuine Spheros hose may be used for the fuel line on the low pressure side between the pressure regulator and the heater. When you install the hose you must ensure that it is an adequate distance (min. 25 mm) from the external casing of the heater or it must be shielded from the heat. Fuel hoses must not be kinked or twisted and must be secured with clamps approx. every 250 mm.

NOTE: Adhere to a minimum bending radius of 125 mm.

11 Combustion air supply

WARNING!	Risk of suffocation!

Under no circumstances may the combustion air be taken from areas occupied by people.

The combustion air intake is to be positioned in such a way that it does not capture the airstream or the airflow from the radiator fan. It must be located so that it safely cannot become clogged with dirt or snow and cannot suck in exhaust gases. Air filter systems are not permitted. Ensure that the permissible temperature of the sucked air will not be exceeded (see Technical Data). Otherwise a combustion air intake line must be installed. If the expected ambient temperature exceeds permanent 65°C, it is recommended to install the opening of the air intake line in an area with lower temperature.

Permissible dimensions of the combustion air intake line:

– Inside diameter: 55 mm
– Max. permissible line length: 3.0 m (without exhaust extension)
– Max. permissible summary of all bends: 450°

A protective grille should be installed onto the air inlet of the intake line.

If the combustion air intake line cannot be installed so that it slopes downwards, a water drain hole with a diameter of 4 mm is to be made at its lowest point.

12 Exhaust pipe

The opening of the exhaust pipe must be aligned against the direction of travel and must not become clogged with dirt or snow.
The outflowing exhaust gas must not be re-sucked in as combustion air.
The exhaust gas must be routed to the outside / into the atmosphere.

The exhaust pipe must be fixed at least once every 50 cm.
Rigid pipes made of unalloyed or alloyed steel with a minimum wall thickness of 1.0 mm, or flexible tubes of alloyed steel are to be used.
The exhaust pipe is to be secured to the heater, e.g. by means of a clamp.
Accumulations of condensate must be drained, if necessary, a condensation water drain hole Ø 4mm must be implemented.
Combustion air intake and exhaust gas outlet must be arranged to ensure that no air pressure difference (e.g. suction) will occur in any vehicle operating condition.

For further requirements see statutory regulations.

Permissible dimensions of the exhaust pipe:

- Internal diameter: 70 mm
- Max. permissible pipe length:
  3 m without the combustion air intake extension
- The total length of both, the air intake pipe and the exhaust pipe must not exceed 5 m
- Max. permissible bend: 270°

Deviations only after approval by Spheros.

NOTE:
If the exhaust line is installed near heat-sensitive parts, it must be insulated.

ATTENTION:
- **The exhaust gas temperature may be up to max. 400 °C.**
- **The exhaust pipe must end in the open air.**
- **The exhaust pipe must be sloped down, arising condensate must be able to drain away.**
- **Because of the temperatures involved, sufficient distance from heat-sensitive or flammable materials must be ensured.**
- **Outflowing exhaust gas must not be re-sucked in as combustion air.**
- **The opening of the exhaust pipe must be aligned against the direction of travel and must not become clogged with dirt or snow.**
- **If the exhaust outlet is under the vehicle floor, blowing straight down, an exhaust gas deflection is absolutely necessary.**

13 Electrical connections

13.1. Heater hook-up

WARNING!	High voltage! Danger of electric shock!

Disconnect the plug connection to the vehicle before you open the heater.

The electrical hook-up of the heater is to be accomplished according to

Fig. 9: System wiring diagram for water heaters Thermo G (with Timer)
Fig. 10: System wiring diagram for water heaters Thermo G (with switch)

Any system circuit diagrams that differ from the standard version (Fig. 9 / Fig. 10) are to be requested separately from Spheros.

Consider the wiring gross-sections shown. If the wires longer, the required wire cross-section increases (see table).

Wire length <7.5m	Wire length 7.5 - 15m
0.75 mm²	1.5 mm²
2.5 mm²	4.0 mm²

Connect the negative and positive terminals of the heater controller direct to the battery.

For the heater a blade-type fuse is to be used according to DIN 72581, part 3. The power supply circuit of the heater is to be protected by F1 = 20A and the circulating pump by F2 = 20A. The main switch wire is to be protected using a 5A fuse.

The required mating plug inclusive the required contacts and single wire seals are supplied with.

Due to the crimp suitablity use FLR cable (sheathed cable with reduced outer diameter).

ATTENTION:
- **The water-proof electrical connection to the heater can only be achieved with genuine plugs, contacts and single wire seals and by using the prescribed crimp tools.**
- **Its absolutely essential to consider the specified cable cross-section.**
- **Route the electrical wires so their insulation cannot be damaged (e.g. by jaming, thermal effects, bending, wearing through). Particularly close to the heater the wire harness is to be fixed to reduce the transfer of vehicle vibrations.**

13.2. Hook-up of the gas pressure regulator

Connect the gas pressure regulator to the heater using the connector “V“ (see wiring diagram).

The wiring harness of the gas regulator has a separate output to control an external solenoid valve in the parking heating mode (see system wiring diagram). There is also a gas regulator version without this output.

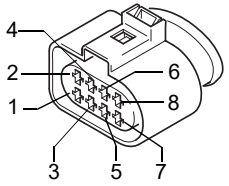
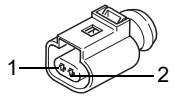
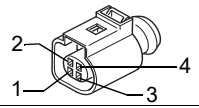
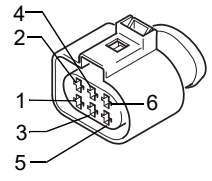
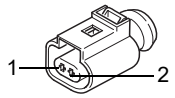
13.3. Wiring diagrams

13.3.1. Legend for wiring diagrams:

Position	Designation
BA	Operation indicator max. 1x5W or 2x2W
BM	Combustion air motor (in the heater)
COGR	Control output gas regulator (optional)
ERH	Electrical regulator heating (gas press. regulator)
F1	Car flat-type fuse 20A acc. DIN 72581 part 3
F2	Car flat-type fuse 20A acc. DIN 72581 part 3
F3	Car flat-type fuse 5A acc. DIN 72581 part 3
F4	Car flat-type fuse 5A acc. DIN 72581 part 3
F5	Car flat-type fuse 5A acc. DIN 72581 part 3
HS	Main switch
MV1	High-press. solen. valve, 1st stage (gas regulator)
MV2	Low-press. solen. valve, 2nd stage (gas regulator)
UP	Circulating pump
UPFA	Circulating pump external control
ZF-Modul	Electronic ignition module (in the heater)

Legend for the wiring diagrams

Cable colors	
bl	blue
br	brown
ge	yellow
gn	green
gr	gray
or	orange
rt	red
sw	black
vi	violet
ws	white

Connector	Description	
C	**To vehicle (Power)**	
C1	Terminal 30 (+)	
C2	Terminal 31 (–)	
C3	--	
C4	UPFA	
C5	Operation indicator +	
C6	Main switch	
C7	Terminal 30 UP	
C8	Terminal 31 UP	
P	**Circulating pump**	
P1	Circulating pump +	
P2	Circulating pump –	
D	**Diagnostic**	
D1	Diagnostic +	
D2	Diagnostic -	
D3	S-Bus	
D4	--	
V	**Solenoid valves and electr. gas regulator heating**	
V1	ERH+	
V2	ERH -	
V3	MV2+	
V4	MV2 -	
V5	MV1+	
V6	MV1 -	
G	**COGR (optional)**	
G1	COGR	
G2	--	

Connector pin assignment

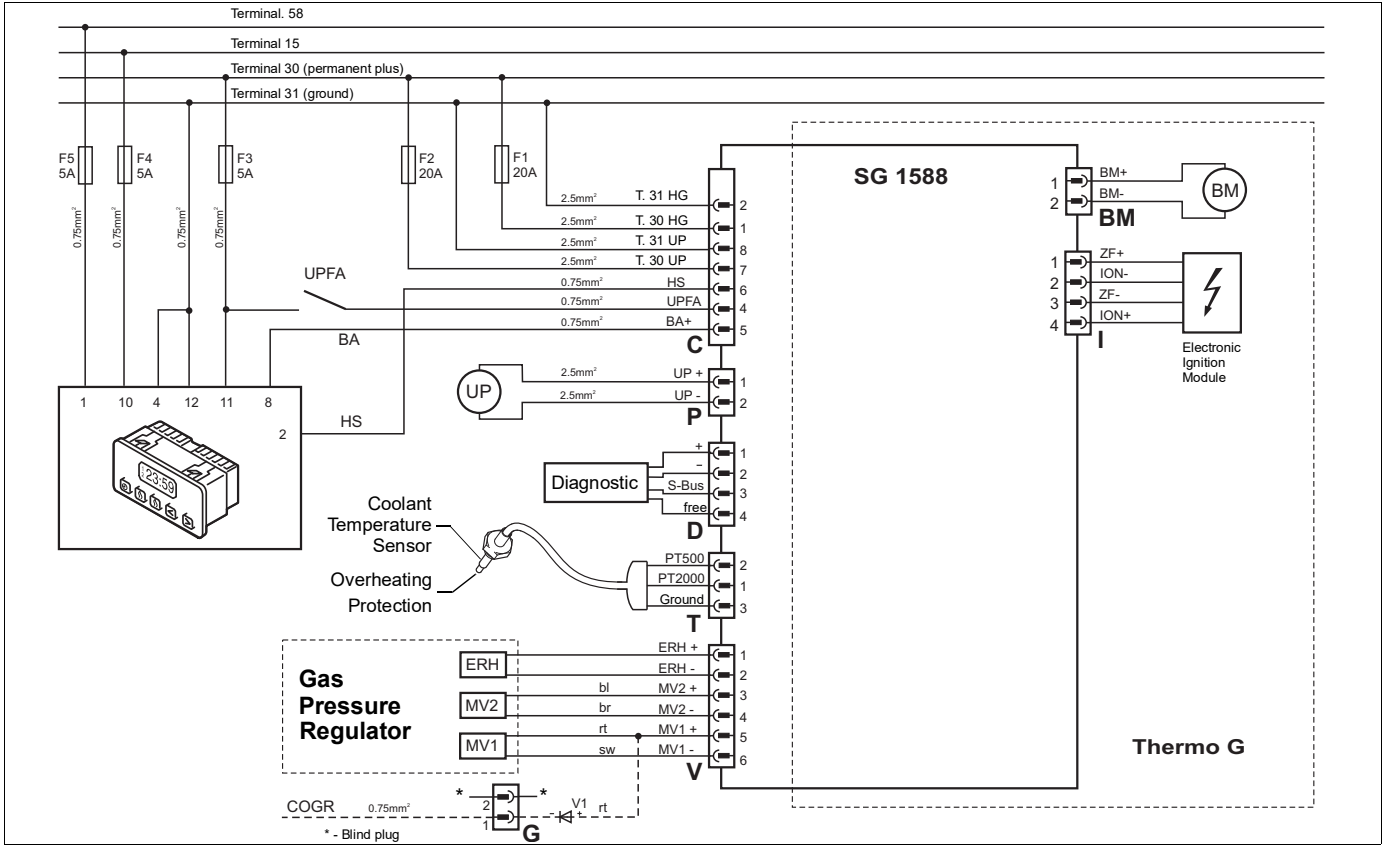


Figure 9: System wiring diagram for water heaters Thermo G with timer, for legend see page 20

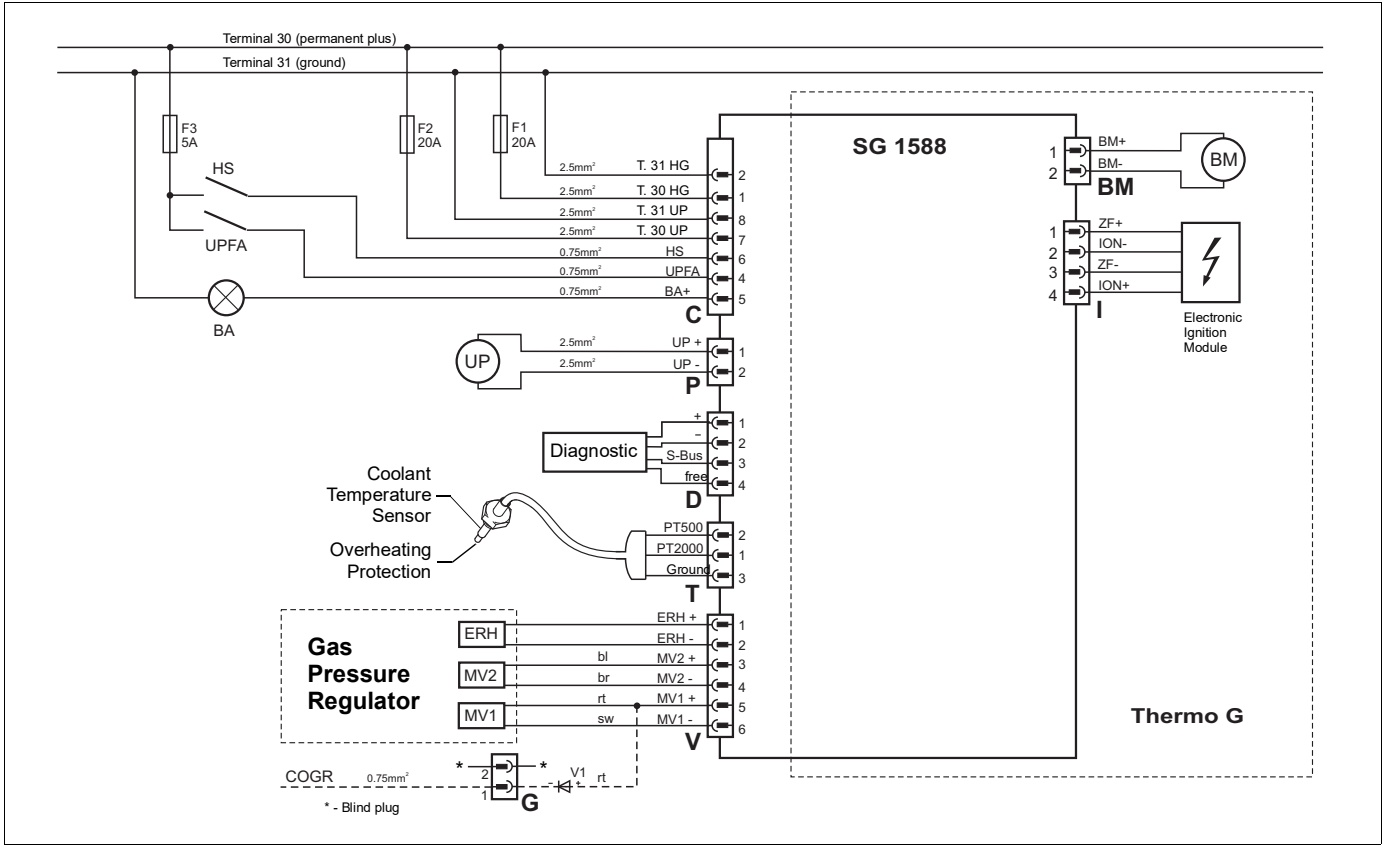


Figure 10: System wiring diagram for water heaters Thermo G with switch, for legend see page 20

14 Initial start-up

ATTENTION:
It is essential to read the Operating and Service Instructions before starting the heater.

WARNING!	**Danger to life and health!**

Read and adhere the safety instructions in the Operating and Service Instructions.

After you have installed the heater, bleed the water system carefully. Follow the instructions supplied by the vehicle manufacturer for this purpose. All the shut-off cocks in the circulation system must be opened.

Start the heater according to the Operating and Service Instructions.

Conduct a trial of the heater to check all the water connections for leaks and to ensure that they are secure. If the heater suffers a fault during operation, the fault must be located and remedied.

15 Maintenance

At the gas pressure regulator the oil that collects at the oil drain screw, must be drained every three months.

16 Troubleshooting

If the heater does not start properly after installation or turns off automatically during operation (Startup and heating), first disconnect power supply to the heater and then check the following:

– verify all system components are properly connected according to the system wiring diagram in figure 9 or 10, all plugs are secure, all fuses present and undamaged
– is the required voltage applied by the power supply (**≥**21 VDC)

  NOTE:
  The gas is sucked in by the blower from the heater. At low voltages the amount of supplied gas is not sufficient. The heater does not start or turns off (fault lock-out).

– is the gas supply to the heater ensured (see Section 10)
– check the combustion air intake and exhaust passages free (see Section 11 and 12).

Turn the heater on again.
Upon recurrence of the fault, the cause must be eliminated first.

NOTE:
A fault lock-out is signalized by a flash code shown by the operation indicator of the heater or by the digital timer.
By means of this flash code the possible cause of the malfunction can be identified. An appropriate error code table is included in the Operating and Service Instructions for the heater.

The Operating and Service Instructions also contain detailed information about the fault lock-out/heater lock-out, their causes and possible measures to remedy them.

Then, reset the heater to cancel the fault lock-out.

If a heater lock-out occurs, please contact the Spheros customer service.

17 Technical data

Except where limit values are specified, the technical data below refer to the usual heater tolerances of ± 10 % at an ambient temperature of + 20 °C and at nominal voltage.

NOTE:
The assignment of circulating pumps to heaters must be made using the water-side resistance.
All desired information regarding the Spheros circulating pumps can be found in the download center on www.spheros.com.

Heater	
ECE type approval number	E1 122R-00 0447 / E1 10R-06 7263
Kind of design	Low-pressure gas burner
Heat output	30 kW ±10%
Fuel	CNG (natural gas) classes H/L
Combustion gas pressure when it enters the heater	-2.5 mbar
Fuel cosumption at CNG class H	< 2.95 kg/h
Rated voltage	24 Volt
Operating voltage range	20.5 ... 30 Volt
Rated power consumption without circulating pump	110 W
Current in standby mode	< 1 mA
Max. current at the circulating pump output	10A
Used gas pressure regulator	M96-E-SP
Max. ambient temperature for the heater and control device	Storage temperature -40 ... +100°C Operating temperature -40 ... +85°C
Permissible sucked in combustion air temp. (permanent)	-40 ... +60°C
Permissible operating overpressure	2.0 bar
Capacity of the heat exchanger	1.8 l
Minimum capacity of the water system	25.00 l
Minimum water flow	2400 l/h
CO_2 in exhaust gas at rated voltage	8.0 ... 9.0 Vol.-%
Switch thresholds	switches off at 82°C ±1K switches on at 72°C ±1K
Heater dimensions (tolerance ± 3 mm)	L 585 mm W 247 mm H 226 mm
Heater weight	19 kg

Gas pressure regulator	
Test certificate	ECE-R110.04, ECE-R10.06
Kind of gas	Natural gas (CNG) class H/L
Permissible oil content in gas	< 10 mg/m³
Input pressure	5 ... 220 bar
Output pressure	-0.25 ... -2.5 mbar
Pressure 1st stage	1.8 ... 3.5 bar
Pressure 2nd stage	0.65 ... 0.75 bar
Operating temperature	-40 ... +100°C
Sorage temperature	-40 ... +120°C
Rated voltage	24 V
Nominal coil power at rated voltage (2x)	24 W
Operating voltage range	20 ... 30 V
Dimensions (tolerance ± 3 mm)	L 150 mm W 130 mm H 170 mm
Weight	1.7 kg

18 Environment

Recycling of heater parts

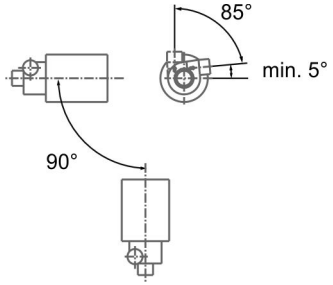
The correct disposal of the heater components determined by material groups for old appliances, damaged or defective parts and packaging material can be realized without problems. In the process the materials as steel, non-ferrous metals, plastics and electrical scrap (as motors, control devices, harnesses and sensors) are to be professionally and environmentally friendly disposed by the recycling plant.

The heater disassembly is precisely described in the workshop manual. For the package the same recycling conditions applies as for paper and paperboard. Keep the package a defined period for a possible return shipment.

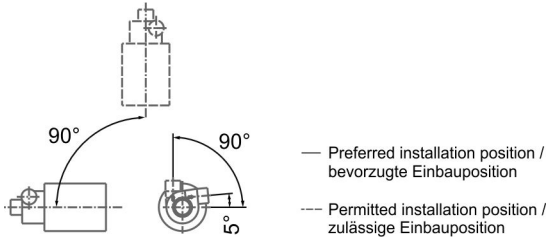
Annex / Anhang / Annexe

Circulating pumps installation position / Umwälzpumpen Einbaulagen / Positions d'installation des pompes de circulation

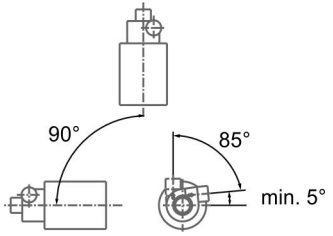
U4814
U4855



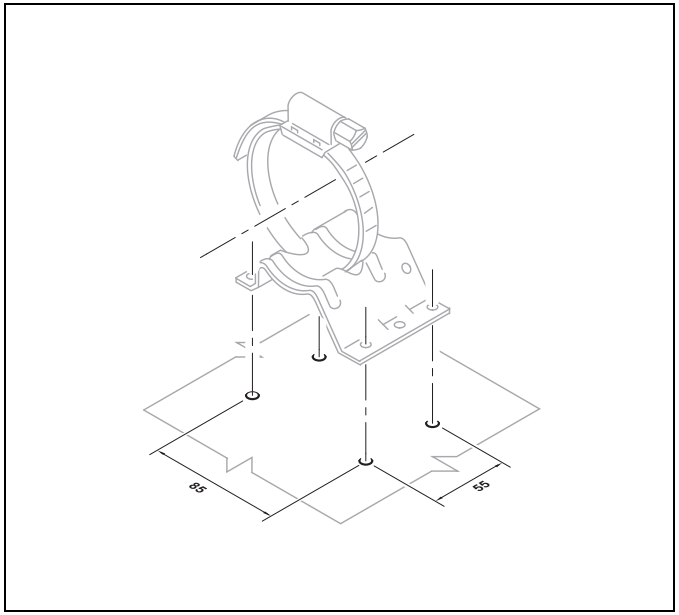
SPump



U4853
U4854
U4856



Lochbild für Ständer / Hole pattern for stand / Schéma des trous pour le support



Notes / Notizen:

memos

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